

CLAIMS

WHAT IS CLAIMED IS:

1. A system for delivering fastener to a work station, said system comprising:

5 at least one fastener storage device including at least one storage tube;
at least one fastener spacer adapted to properly orient at least one fastener stored in the storage tube; and

at least one unloading mechanism including at least one extractor catcher, the unloading mechanism adapted to remove the spacer and the fastener from
10 the storage tube in a single operation.

2. The system of Claim 1, wherein the unloading mechanism is further adapted to:

retain the fastener within the extractor catcher; and

substantially simultaneously transport the spacer to a spacer
15 storage receptacle, via spacer transport tube.

3. The system of Claim 2, wherein the unloading mechanism is adapted to utilize a vacuum force that retains the fastener in the extractor catcher and transports the spacer through the extractor catcher and an extractor tube coupled to the extractor catcher.

20 4. The system of Claim 3, wherein the unloading mechanism includes at least one vacuum means adapted to create the vacuum force that retains the fastener in the extractor catcher and transports the spacer through the extractor catcher and an extractor tube coupled to the extractor catcher.

5. The system of Claim 3, wherein the vacuum generator is further adapted to create a vacuum exhaust that propels the spacer through the spacer transport tube into the storage receptacle.

6. The system of Claim 3, wherein the vacuum generator includes at least one intake port to facilitate retaining the fastener in the extractor catcher while the spacer is transported to the storage receptacle.

7. The system of Claim 3, wherein the spacer is further adapted to have an outside diameter that is sized to allow the spacer to pass through the extractor catcher, the extractor tube, the vacuum generator, and the spacer transport tube to be deposited in a storage receptacle.

8. The system of Claim 3 wherein the extractor catcher includes a chamfered opening in a first end that leads into a channel connecting the opening to a recess in a second end of the extractor catcher, wherein the chamfered opening is adapted to facilitate removing the spacer and fastener from the storage tube, and to allow the spacer to pass through the extractor catcher while retaining the fastener therein.

9. The system of Claim 8, wherein the extractor catcher further includes at least one intake port adapted to allow air to be drawn into the extractor catcher after the fastener has been stopped by the chamfered opening, thereby allowing the vacuum force to transport the spacer through the extractor catcher and the extractor tube where the vacuum exhaust propels the spacer through the spacer transport tube to the storage receptacle.

10. The system of Claim 3, wherein the extractor catcher includes an opening in a first end that includes a first chamfered portion adapted to facilitate removing the spacer and fastener from the storage tube.

11. The system of Claim 10, wherein the opening further includes a second chamfered portion that leads into a channel connecting the opening to a recess in a second end of the extractor catcher opposite the opening, the second chamfered portion adapted to allow the spacer to pass through the extractor catcher while retaining the fastener therein.

12. The system of Claim 11, wherein the extractor catcher further includes at least one intake port adapted to allow air to be drawn into the extractor catcher after the fastener has been stopped by the second chamfered portion, thereby allowing the vacuum force to transport the spacer through the extractor catcher and the extractor tube where the vacuum exhaust propels the spacer through the spacer transport tube to the storage receptacle.

13. The system of Claim 1, wherein the spacer includes a recess adapted to loosely fit around a tail end of a mandrel of the fastener.

14. The system of Claim 13, wherein the recess includes a chamfered upper portion adapted to provide a self-locating feature such that when the spacer is dropped into the storage tube after a fastener has been inserted into the storage tube, the tail end of the mandrel is positioned within the recess without manipulating the fastener and the spacer.

15. The system of Claim 13, wherein the recess is adapted to have depth that extends a substantial distance into the spacer such that an end wall of the spacer creates only a slight separation between the tail end of a mandrel of a first fastener in the storage tube and a head end of the mandrel of an adjacent fastener in the storage tube, thereby allowing more fasteners to be stored in the storage tube.

16. A method for delivering fasteners to a work station, said method comprising:

loading at least one storage tube of at least one storage device with at least one fastener and at least one spacer adapted to properly orient the fastener within the storage tube;

substantially simultaneously retrieving the fastener and the fastener spacer from the storage tube utilizing an unloading mechanism;

substantially simultaneously retaining the fastener within an extractor catcher of the unloading mechanism and transporting the spacer to a spacer storage receptacle; and

depositing the fastener in a delivery conduit adapted to transport the fastener to a work station.

17. The method of Claim 16, wherein retrieving a fastener and spacer from the storage tube comprises utilizing a vacuum force that removes the fastener and spacer from the storage tube.

18. The method of Claim 16, wherein utilizing a vacuum force comprises creating the vacuum force utilizing at least one vacuum generator included in the unloading mechanism.

19. The method of Claim 17, wherein retaining the fastener within the extractor catcher and transporting the spacer to the storage receptacle comprises:

retaining the fastener within the extractor catcher utilizing the vacuum force;

substantially simultaneously transporting the spacer through the extractor catcher and the vacuum generator utilizing the vacuum force; and

propelling the spacer through a spacer transport tube to the storage receptacle utilizing a vacuum exhaust created by the vacuum generator.

20. The method of Claim 19, wherein retaining the fastener within the extractor catcher and transporting the spacer to the storage receptacle further comprises:

retaining the fastener within a chamfered opening in a first end of the extractor catcher, whereby the chamfered opening leads into a channel extending through the extractor catcher; and

drawing air into the extractor catcher after the fastener has been stopped by the chamfered opening via an intake port that is in communication with the channel, thereby allowing air to flow through the extractor catcher so that the spacer is substantially simultaneously transported through the extractor catcher.

21. The method of Claim 19, wherein retaining the fastener within the extractor catcher and transporting the spacer to the storage receptacle further comprises:

retaining the fastener within a chamfered portion of an opening in a first end of the extractor catcher, whereby the chamfered portion of the opening leads into a channel extending through the extractor catcher; and

drawing air into the extractor catcher after the fastener has been stopped by the chamfered portion via an intake port that is in communication with the channel, thereby allowing air to flow through the extractor catcher so that the spacer is substantially simultaneously transported through the extractor catcher.

22. The method of Claim 16, wherein loading at least one storage tube comprises:

inserting the fastener into the storage tube;

subsequently inserting the spacer into the storage tube whereby a recess in the spacer having a chamfered upper portion self-locates on a mandrel of the fastener such that the mandrel is positioned loosely within the recess without manipulation of the fastener and the spacer.

23. An unloading apparatus for a fastener delivery system, said apparatus comprising:

at least one extractor tube in communication with a vacuum source that provides a vacuum force utilized by the unloading apparatus to substantially
5 simultaneously remove a fastener and a fastener spacer from a storage device; and

at least one extractor catcher coupled to the extractor tube, wherein the extractor catcher is adapted to retain the fastener while substantially simultaneously allowing a fastener spacer to be transported to a spacer storage
10 receptacle.

24. The apparatus of Claim 23, wherein the vacuum source comprises at least one vacuum generator coupled to the extractor tube.

25. The apparatus of Claim 24, wherein the vacuum generator includes at least one intake port to facilitate retaining the fastener in the extractor catcher
15 while the spacer is transported to the storage receptacle.

26. The apparatus of Claim 23 wherein the extractor catcher includes a chamfered opening in a first end that leads into a channel connecting the opening to a recess in a second end of the extractor catcher, wherein the chamfered opening is adapted to facilitate removing the spacer and fastener from the
20 storage device, and to allow the spacer to pass through the extractor catcher while retaining the fastener therein.

27. The apparatus of Claim 26, wherein the extractor catcher further includes at least one intake port adapted to allow air to be drawn into the extractor catcher after the fastener has been stopped by the chamfered opening,
25 thereby allowing the vacuum force to transport the spacer through the extractor

catcher and the extractor tube where a vacuum exhaust propels the spacer through a spacer transport tube to the storage receptacle.

28. The apparatus of Claim 23, wherein the extractor catcher includes an opening in a first end that includes a first chamfered portion adapted to
5 facilitate removing the spacer and fastener from the storage tube.

29. The apparatus of Claim 28, wherein the opening further includes a second chamfered portion that leads into a channel connecting the opening to a recess in a second end of the extractor catcher opposite the opening, the second
chamfered portion adapted to allow the spacer to pass through the extractor
10 catcher while retaining the fastener therein.

30. The apparatus of Claim 29, wherein the extractor catcher further includes at least one intake port adapted to allow air to be drawn into the extractor catcher after the fastener has been stopped by the second chamfered portion, thereby allowing the vacuum force to transport the spacer through the
15 extractor catcher and extractor tube where a vacuum exhaust propels the spacer through a spacer transport tube to the storage receptacle.

31. A method for delivering fasteners to a work station, said method comprising:

substantially simultaneously retrieving a fastener and a fastener spacer from the storage tube utilizing an unloading mechanism;

5 substantially simultaneously retaining the fastener within an extractor catcher of the unloading mechanism and transporting the spacer to a spacer storage receptacle; and

depositing the fastener in a delivery conduit adapted to transport the fastener to a work station.

10 32. The method of Claim 31, wherein retrieving a fastener and spacer from the storage tube comprises utilizing a vacuum force that removes the fastener and spacer from the storage tube.

33. The method of Claim 31, wherein utilizing a vacuum force comprises creating the vacuum force utilizing at least one vacuum generator
15 included in the unloading mechanism.

34. The method of Claim 32, wherein retaining the fastener within the extractor catcher and transporting the spacer to the storage receptacle comprises:

retaining the fastener within the extractor catcher utilizing the vacuum
20 force;

substantially simultaneously transporting the spacer through the extractor catcher and the vacuum generator utilizing the vacuum force; and

propelling the spacer through a spacer transport tube to the storage receptacle utilizing a vacuum exhaust created by the vacuum generator.

35. The method of Claim 34, wherein retaining the fastener within the extractor catcher and transporting the spacer to the storage receptacle further comprises:

5 retaining the fastener within a chamfered opening in a first end of the extractor catcher, whereby the chamfered opening leads into a channel extending through the extractor catcher; and

drawing air into the extractor catcher after the fastener has been stopped by the chamfered opening via an intake port that is in communication with the channel, thereby allowing air to flow through the extractor catcher so that the
10 spacer is substantially simultaneously transported through the extractor catcher.

35. The method of Claim 34, wherein retaining the fastener within the extractor catcher and transporting the spacer to the storage receptacle further comprises:

15 retaining the fastener within a chamfered portion of an opening in a first end of the extractor catcher, whereby the chamfered portion of the opening leads into a channel extending through the extractor catcher; and

drawing air into the extractor catcher after the fastener has been stopped by the chamfered portion via an intake port that is in communication with the channel, thereby allowing air to flow through the extractor catcher so that the
20 spacer is substantially simultaneously transported through the extractor catcher.